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JPRS L/8932

20 February 1980

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

(FOUO 2/80)

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WORLDWIDE AFFAIRS

'LIBERATION' SCORES WESTERN EXPORTS OF ROESSING URANIUM

Paris MARCHES TROPICAUX ET MEDITERRANEENS in French 14 Dec 79 p 3477

[Text] The extreme-left Parisian daily LIBERATION recently waged a campaign against western companies mining uranium in Roessing, Namibia.

The daily asserts that the Roessing mining is done by companies originating in Great Britain, Canada, South Africa and France. The company operating on France's behalf is Minatome, whose capital is owned by Pechiney-Ugine-Kuhlman (50 percent) and by Compagnie Francaise des Petroles (50 percent). Company headquarters confirms that Minatome is a 10 percent participant in Roessing mining, where annual production is 5,000 tons of uranium (France's annual production: 3,400 tons).

Roessing uranium, LIBERATION also reported, is routed to France by UTA airlines to a reprocessing plant located near Narbonne, and then sold to the FRG, the Netherlands, Great Britain and France (to Electricite de France, among others).

That exportation, the daily points out, is contrary to the UN recommendation of 24 September 1974 declaring in particular, that "no organized entity may mine [...] or export any natural resource located within Namibia's territorial boundaries."

Following that campaign, the UTA management reported that the contract according to which the company had been transporting uranium from Namiba to France had been terminated, and that the product mined in Roessing would henceforth be shipped by sea.

The AFP then announced that the "Compagnie Maritime des Chargeurs Reunis" [United Carriers Shipping Company] was already transporting Roessing uranium from Walvis Bay harbor.

11936
CSO: 4400

JAPAN

NO NEW REACTORS TO START COMMERICAL OPERATIONS IN 1980

OW211901 Tokyo MAINICHI DAILY NEWS in English 19 Jan 80 p 5 OW

[Text] No new nuclear reactors will have started commerical operation in Japan this year for the first time in seven years, according to power industry sources. Surging antinuclear sentiment and delays in reactor construction were blamed.

Up to last year Japan had seen one or two new reactors start commercial services every year since the first operation of Kansai Electric Power Co.'s Mihama No. 1 reactor in Fukui Prefecture in 1970.

Nuclear power accounted for some 13 percent of the total power generation as of last year, generating 14.95 million kilowatts. Nuclear reactors now in service total 21 across the nation.

Originally, two new reactors were expected to go into service this year operated by Kyushu and Shiloku Electric Power Cos. But prevailing antinuclear sentiment has blocked the construction scheduled for this year because the authorities in charge of nuclear reactors were forced to take a cautious attitude concerning new construction.

CSO: 5100

JAPAN

BRIEFS

URANIUM ENRICHMENT PLANT--Japan's power reactor and nuclear fuel development corporation has decided to embark in fiscal 1980 on a project to build a pilot plant for uranium enrichment by centrifugal separation with an annual capacity of 250 tons. The new plant's scale will be slightly over three times that of the plant currently in partial operation at Ningyotoge, Okayama Prefecture. The corporation plans to spend 220 million yen in 1980 for preliminary designing and to complete detailed designing in 1981, begin construction in 1982, and initiate partial operation of the plant in 1984 and full operation in 1986. The total construction cost is estimated at 60 billion yen. [Tokyo NIHON KEIZAI SHIMBUN in Japanese 12 Jan 80 morning edition p 6 OW]

LASER-INDUCED FUSION--Osaka University's laser nuclear fusion research center will this year start a 10-year project to develop laser-triggered nuclear fusion, which is expected to become the main source of energy in the 21st century. Under the project, called the "Kongo plan," the center aims at developing in 8 years a mechanism with which to bring about a "break-even" condition, needed for inducing a nuclear fusion reaction, in which energy input equals energy output produced by nuclear fusion. The center, headed by Professor Chiyoei Yamanaka, aims at building a 20-kilojoule "Gekko XII" laser and developing fuel pellets efficient for compression purposes in the first 5 years. With an investment of about 6 billion yen, "Gekko XII" laser, comprising 12 large-caliber glass laser beams of 30 cm in diameter, will be built in 3 years. Initially, an outlay of some 1,950 million yen has been approved under the fiscal 1980 budget. The total cost needed for the first half of the "Kongo plan," including the development of fuel pellets, is estimated at 12 billion yen. In the second half of the plan, beginning in 1985, the center hopes to develop a 100-kilojoule laser mechanism, 5 times that of "Gekko XII" and achieve a "break-even" condition. [Tokyo NIHON KEIZAI SHIMBUN in Japanese 9 Jan 80 morning edition p 1 OW]

CSO: 5100

CZECHOSLOVAKIA

PRODUCTION OF NUCLEAR POWER PLANT COMPONENTS PLANNED

Prague INVESTICNI VYSTAVBA in Czech No 10, 1979 pp 259-263

[Article by Rudolf Rokos]

[Text] As is also the case in the advanced capitalist countries, the CEMA countries are also faced with a widening gap between the growing demand for electric power and the ability to generate this power by such conventional means as coal, oil and natural gas. Scientists are engaged in an intensive research effort aimed at finding ways to harness energy from heretofore unconventional sources such as solar power, geothermal power, ocean tidal power, wind power, and so on. All of these power generating methods are still in the research stage and it is not realistic to expect that they will be harnessed on any significant scale before the year 2000 due to high investment costs, their variable dependability as an energy resource, and, therefore also, their low efficiency. The only new energy resource that is being developed on an industrial scale at the present time is the energy unleashed by the atom as a source of heat for running nuclear power plants.

Even though the worldwide distribution of accessible reserves of conventional fuels works out to the advantage of the CEMA countries, especially the USSR, it is still necessary in these countries too to provide for most of the needed growth in the production of electric power by building nuclear power plants.

As a direct result of this policy it is also essential that efforts should be made to build up a suitable manufacturing base for the production of machinery and equipment for the nuclear power industry. Within the context of the international division of labor the CSSR has been assigned the task of producing key primary-zone components for VVER 440 and VVER 1000 nuclear power plants. One of the VHJ's charged with carrying out this task is the sectoral enterprise Skoda-Plzen, whose production program has been modified to include the following key components:

--pressure vessels housings,
--internal components for pressure vessel housings,
--horni blok [translation unknown],
--and fuel-assembly control mechanisms.

In view of the fact that Skoda-Plzen has never before produced such large-scale, heavy equipment, it was necessary to invest capital in the construction of new production capacities.

In order to carry out this very challenging and, in all of its phases, technologically unprecedented task it was necessary to select the right kinds of organizations for participation in this construction work in order to insure that they would be able to put their technical knowhow and capabilities to work with a view to resolving the problems at hand. The task of designing and erecting the reactor assembly building was declared to be a mandatory, government monitored task, and the following organizations were chosen to take part in the construction project:

--the investor--a special division charged with overseeing capital investment activities in connection with the construction of the reactor assembly building was established in the sectoral enterprise Skoda-Plzen;

--general engineer--KOVOPROJEKTA, Prague;

--general contractor in charge of construction--ARMABETON national enterprise, Prague, plant no 4, Plzen.

The following major subcontractors were also designated as being responsible for the overall fulfillment of all related tasks:

--Road and Railroad Construction, national enterprise, Prague,

--Hydraulic Construction, national enterprise, Prague,

--Kralovopolske Engineering Works, Brno (responsible for the manufacture of steel structural components),

--general engineering contractor--Engineering-contractor Division of Skoda-Plzen (while other selected divisions of Skoda-Plzen were designated as manufacturers of structural components and suppliers of non-standard equipment),

--CHEMONT, Brno (responsible for the installation of structural steel components).

In the course of completing design and planning work and during the actual realization of this design work all contractors were confronted with tasks which they had never worked on before.

Design work proceeded according to the following schedule:

--preliminary studies of all proposed construction projects--September 1973 (10 projects in all);

--reactor assembly building design project--March 1974 (construction projects 1 and 2);

--reactor assembly building draft design work--December 1974 (construction projects 1 and 2);

--reactor assembly building final design work--1974-1978.

Construction projects No 3 through No 10 mainly involve the reconstruction or expansion of existing Skoda-Plzen divisions, and the design work for these projects was performed by the investor or by its subcontractors.

Reactor assembly building construction work, the realization of which was originally split up into two separate projects, was performed by KOVOPROJEKTA of Prague in its capacity as general engineer:

--project no 1--building site preparation work (costing approximately Kcs 70 million) which for the most part laid the groundwork for the start of work on the construction of the reactor assembly building itself by virtue of the fact that this work involved:

a) the erection of new installations in place of those that were demolished,

b) earthmoving excavation work at the reactor assembly building construction site (about 350,000 cubic meters of earth were excavated),

c) the installation of main sewer lines for the reactor assembly building premises with the prospect that additional sewer lines would be installed on the south side of the reactor assembly building,

d) the construction of retaining wall marking the southern perimeter of the reader assembly building site (300 meters long and 12 meters high);

--project no 2--the construction of the reactor assembly building itself, including 49 auxillary and power-supply installations; the total cost (II -- VIII) of project no 2 came to Kcs 1,330,000/680,000,000.

Planning the Construction of the Reactor Assembly Building and the Terms Under Which These Plans Were Drawn Up

During the course of finalizing plans for the construction of the reactor assembly building the following principal factors had to be taken into account:

--the limited number of feasible building sites given the wellknown fact that a high percentage of land on the grounds of the Skoda-Plzen sectoral enterprise is already built up, the minimal opportunities for developing lots that are still vacant and also in view of the condition of these vacant lots;

--transportation links with other divisions and plants on the grounds of the Skoda-Plzen sectoral enterprise that will perform auxillary functions in connection with production work in the reactor assembly building;

--the selection of a site for the reactor assembly building was also influenced by its high energy intensiveness, that is, the building had to be located as close as possible to existing power sources and it had to be located on a site that would make it possible to build new power sources in its immediate vicinity (a new high-voltage switching station, a CO_2 and argon degasification station, and so on).

The general engineer proposed a total of four alternative sites and designs for the reactor assembly building, and at joint meetings with the management of the Skoda-Plzen sectoral enterprise that option was selected which best suited the given conditions. This option then underwent further refinements during the course of preliminary and final design work.

The most important technical problems can be described broadly as follows:

--During the preparation of feasibility studies on all of the slated construction projects, the design task, the draft design and most of the operational designs no work was being done on the preparation of production technology designs and the investor, at considerable risk, only went so far as to lay down "production technology guidelines" for the mechanical-engineering components of the VVER 440 series.

--During the writing of the draft design certain key parameters of the construction project and certain systems components had to be modified to accommodate future plans for the production of VVER 1000 reactors. And the investor had to gear up for this production program without a detailed knowledge of all the technical ramifications of this reactor model.

--The minimal time frames for all aspects of the project made it necessary for the general engineer to furnish in advance single-stage or operational designs for the entire installation or for certain parts of the installation as was required by the moving up of construction deadline. For example, the design of the reactor assembly building itself, which consists of four assembly bays and give annex installations, was written up and gradually delivered in 32 installments. At the same time growing familiarity with the production technologies involved required and will continue to require so-called "in-process" design modifications. In the case of the general engineer this resulted in the issuance of 170 supplementary design modifications, the writing up of which has thus far taken around 40,000 design working hours.

--Due to the very severe time pressure work on the production of key steel structural components had to get under way as early as 1974; under the terms of the design task plan it was necessary for bays 1 and 2 and for the west-end tranverse bay of the reactor assembly building to furnish essential data to the manufacturers of steel structural components so that they would be able to obtain the necessary assortment of fabricating materials on time. It followed from this that the structural steel design had to be completed roughly a year in advance of the other design work. During the time when the production of the steel structural components was in full swing work went ahead on the other designs on the condition that allowances had to be made for the specifications of the key structural steel components (loading, dimensions, and so on). Problems did crop up as well, for example, in connection with the determination of the fixed load factors of the overhead traversing cranes (at the level of the design task plan). Further, it was only natural that the designs would be subject to revisions and clarifications, but such modifications are an inevitable by-product of work on the design of any large-scale project. It can now be said, with the advantage of hindsight, that this risky approach to the handling of this design work was a success and that this paved the way for the delivery of most of the structural steel components to the construction site. If this approach had not been taken, the construction work would have been held up for from 1 to 1 and a half years at the very least.

--It was necessary to put in advance orders for excavation work in the reactor assembly building that could be carried out only by means of Milan walls; these are shafts at depths of 17, 21 and 34 meters on the footing bottom, and the deepest shaft has dimensions of 30 x 36 m. The troublesome geological conditions were compounded by the presence of underground water, whose constant level ranges around 6 to 8 meters below the surface. This is where the extensive experience of the national enterprises Hydraulic Construction and Water Resources came in handy. Agreements were reached with these organizations both with respect to the technology used to line the shafts and the technique used to lower the groundwater level to the level of the footing bottom by means of a network of 16 wells, the deepest of which was drilled to a depth of 50 meters. The water started to be pumped out in 1976 and the pumps will be kept running until work is finished on the pouring of the concrete for the structural concrete sections inside the shaft of the hardening room (December 1979), when the ground water will then be permitted to return to its normal level. The volume of water that is being pumped ranges between 10 and 50 liters per second depending on weather conditions. The total cost of drilling the wells and running the pumps until their job is finished is set at approximately Kcs 13 million.

--Since the excavated facilities will house process work areas, requiring dry, well ventilated surroundings, it was necessary to seal these areas completely against seepage water. The experience gained by the national enterprises Hydraulic Construction and Water Resources of Prague in the construction of the Prague Metro was helpful in this regard and a decision was made to use TROCAL waterproofing insulation. Ventilation is provided by separate HVAC machine rooms.

--The complex geological conditions, the presence of groundwater and the sensitivity of the structural steel framing to settling also imposed special demands on the design of the building's foundation. While working on the design of the foundation at a time when not even the draft design of the floorwork had been completed, the general engineer operated under the assumption that in the future the floor structure would have to support a load of 50 tons per square meter and that floorplan would be crisscrossed by a network of cable-run conduits linking the individual switchgear rooms and transformers with the work areas. But at the time when the designs were being drawn up for the footings nobody knew the exact location of either the work areas or the cable-run conduits. In order to minimize the risk of a collision the level at which the structural steel components intersect with the footings was set at 4 meters below the floor surface. After the completion of loading tests using test piles the foundation was laid on the footings, the tops of which measure 6 x 10 meters and are two meters thick and rest on twelve piles.

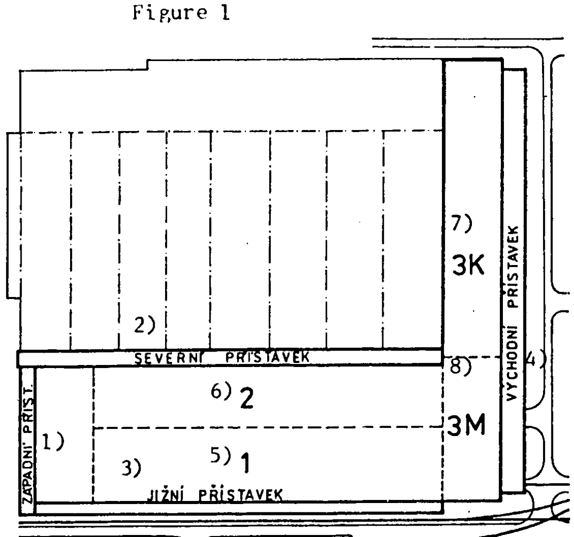
--The pressures created by the tight deadline for the delivery of the first reactor vessel made it necessary to plan the layout of the entire building in a way that would permit the phased startup of plant operations in pace with the production scheduling requirements for the first unit and the subsequent acceleration of production schedules while construction work is still in progress. So the construction work schedule was split up into four phases. The adoption of this approach meant that it was necessary to plan and carry out construction work in such a way so that every section of the plant would be capable of functioning as an independent unit in terms of its structural and power-supply requirements (self-contained power-supply zones), provided that each additional section of the plant can be hooked up to the final, integrated power-supply system, including power feeds for monitoring and control systems.

Structural Design

The floorplan layout diagrammed in Figure 1 shows what the reactor assembly building will look like when all construction work is completed. This diagram also indicates that section of the reactor assembly building which is the focal point of current construction work.

Diagram 1. Floorplan of the Reactor Assembly Building

Figure 1



Key:
1. West annex
2. North annex
3. South annex
4. East annex
5. Bay No 1
6. Bay No 2
7. Hardening room bay No 3
8. Assembly room bay No 3

The floorplan and overhead layout of the reactor assembly building was a product both of the projected production technology and of the location of the building in relation to existing plant facilities, and, last but not least, architectural considerations were also taken into account.

The reactor assembly building proper consists of bays No 1 and No 2. The west side bay No 1 (with a modulus span of 36 x 24 m) and bay No 2 (with a modulus span of 30 x 24 m) lies adjacent to a cross bay with a modulus span of 30 x 24 m. This space is supposed to be occupied by an annealing furnace, an X-ray apparatus and a betatron. On the east side bays No 1 and No 2 are adjoined by a final assembly bay (bay 3M) and a hardening-room bay (bay 3K), both of which have a modulus span of 30 x 24 m.

The west-end cross bay lies adjacent to the west annex with a modulus span of 7 meters, and bay No 1 lies adjacent to the south annex with a modulus span of 5.75 meters. Bay No 2 is adjoined by the north platform with a modular span of 10.5 meters and bays 3M and 3K are abutted by the east annex, with a modulus span of 12.0 meters. A yard crane track is laid out on the east side of the reactor assembly building. The structural support components of the reactor assembly building were designed to make allowances for process engineering requirements (loading of the crane, spacing of structural support components, and so on) while also taking into account the cost-effectiveness of the proposed structural design.

In the course of drawing up the draft design a maximum effort was made to preserve a uniform structural support spacing of 24 meters. On the basis of this modular grid design a structural support system was proposed that minimized steel consumption. A double fixed-end framing design was selected as being most economical for a structural steel support system of these parameters and in view of the heavy loading and multilevel mobility requirements of the cranes.

The breakdown for the plant's floorspace usage is noted in Table 1 and the investment costs (Kcs per square meter) of the floorspace taken up by the building's installations are given in Table 2.

The Static System

The supporting structural steel for bays No 1 and No 2 consists of continuous, fixed-end, unit-welded and full-wall double-span frames (36.0 + 30.0 meters) with spacing intervals of 24.0 meters. The height of the frame in bay No 1 is approximately 38.0 meters (with the rooftop annex, in which an assembly crane is housed for performing repairs on the operational cranes, the height increases to 42.0 meters), while the height of the frame for bay No 2 is around 28.0 meters (with the rooftop annex--approximately 32.0 meters). The footings of the columns are imbedded in the concrete foundations by means of concrete-encased anchor bolts. This framing design insures the transverse rigidity of bays No 1 and No 2, whereas their longitudinal rigidity is insured by span braces between frames 4 through 5 through 9 and 10 in all rows (A, B, C).

Table 1.

1) Provozní plocha základní výroby	2) Pomocné obslužné hospodářství		5) Neprovozní			
	3) energetika	4) sklady	sociální 6	správní 7	ostatní 8	
43,7	14,2	14,3	5,5	8,8	13,5	100 %

Key:
1. Main production area floorspace
2. Auxillary services floorspace
3. Power supply
4. Storage areas
5. Nonoperational floorspace
6. Social services
7. Administration
8. Miscellaneous

Table 2

1) Název	Kčs/m²	Název	Kčs/m²
2) stavební		3) technologické	
4) stavební E hl. III	19 571	technologie E hl. II 10)	25 068
5) z toho		z toho 11)	
6) ocelové konstrukce	8 165	strojní technologie 12)	22 814
7) hlubinné objekty	5 890	silnoproud 13)	1 275
8) stavební instalace	389	vzduchotechnika 14)	702
9) ostatní stavební	5 127	technické trubní rozvody 15)	173
		vodohospodářské zařízení 16)	124

17) Údaje jsou zprůměrovány na celou podlahovou plochu hal

Key:
1. Category
2. Structural
3. Process
4. Total building cost
5. including:
6. structural steelwork
7. excavated installations
8. structural installations
9. miscellaneous building costs
10. Total process costs
11. including:
12. Machinery
13. Power
14. HVAC
15. Process piping
16. Water supply equipment
17. values are averaged out for the total floorspace of the reactor assembly building

Much the same as in the case of bay No 1, the supporting structure of bays 3M and 3K consists of fixed-end frames with a modulus span of 30.0 meters. The height of the frames is 38.0 meters (42.0 meters including the roof annex). The spacing of the frames at 24-meter intervals, sometimes at 15- and 16.5-meter intervals, insures the transverse rigidity of bays 3M and 3K. The longitudinal rigidity is insured by longitudinal braces in rows 11 and 12. In view of the equipment layout the brace in the lower section consists of a full-wall portal, while in the upper section it consists of a panel brace similar to that used in bay No 1.

The supporting frames themselves are 3 x 0.9 meter columns which are unit-welded and box-shaped (closed). The continuous frame in bays No 1 and No 2 weighs approximately 415.0 tons, and the frame in bays 3M and 3K weighs approximately 270.0 tons. The KOPR [expansion unknown] program of the Klement Gottwald Vitkovice Ironworks was used on an ICL computer to perform static calculations for all frame structures.

The maximum weight of a component with dimensions of 12-5.8-0.9 meters is 45 tons. Individual assembly components are put together on site and it is during this phase that individual assembly footings are also supplied.

The entire installation consists of four structural engineering phases:

1. The first phase encompasses the construction of the west cross bay, the annexes, and bays No 1 and No 2 up to and including row No 7; the weight of the supporting structural steelwork installed during phase 1 comes to 6,550,000 tons.

2. The second phase encompasses the construction of the annexes and the rest of bays No 1, No 2 and 3M, including the east annex, the weight of the supporting structural steelwork installed during phase 2 comes to 6,900,000 tons.

3. The third phase encompasses the construction of bay 3K, including its east annex; the weight of the supporting structural steelwork installed during phase 3 comes to 5,128,000 tons.

4. The fourth phase encompasses the construction of the yard crane track; the weight of the supporting structural steel work installed during phase 4 comes to 1,272,000 tons.

The total weight of the supporting structural steelwork comes to 19,850,000 tons. The volume of steel used during construction amounts to 19 kg per cubic meter of enclosed space.

Overall Structural Design (Excluding Structural Steel)

Special requirements facing plant engineering and electrical construction trades

Only the most basic requirements have been omitted from the following list:

--the flooring of all production facilities will have a load-carrying capacity of 50 tons per square meter and all surface cable runs will be continuous;

--with the exception of the foundations of heavy machine tools all other work areas (including all non-standard equipment manufactured for this plant by other divisions of Skoda-Plzen or special imported equipment) will be installed on slatted platforms with the same load-carrying capacity;

--power will be supplied from distribution-transformer and switchgear rooms through buried cable-run conduits beneath the aisles and fed through branch circuits underneath every slat platform with provisions being made for the installation of one receptacle in every other gap between the slats;

--all other energy sources, i.e., water, acetylene, oxygen, CO_2, compressed air and cooling and heating system water, will be installed after the completion of construction work with provisions being made so that, where necessary, these power sources can be fed to individual work stations through the nonelectrified gaps between the platform slats;

--reactor assembly building facilities will be heated by a central hotwater heating system with a temperature gradient of 160/80°C (with a working pressure of 1.3 MPa) and a warm water heating system with a temperature gradient of 90/70°C (with a working pressure of 0.4 MPa).

The layout of the reactor assembly building's production bays was designed in such a way so that operational and social-services annexes are located along the perimeter walls. This arrangement reduced heat loss through the outside walls by nearly 65 percent. This meant that the heat consumption indicators for one cubic meter of heated space did not exceed the same indicators for conventional engineering plant buildings (18.6 kW/m^3).

Due to the height of the individual bays (ranging between 25 and 40 meters) they could not be heated with warm air intake units with axial-flow blowers. Working together with the HVAC engineer it was recommended instead that the individual production bays of the reactor assembly building should be heated by a warm-air system fed through the HVAC rooms located in the respective annex areas. In view of the large amount of heating ductwork that had to be installed (connecting the annex areas and, in some cases, the HVAC rooms) the central-heating engineer had to determine in advance the positioning of the heating ductwork and the load that this ductwork would place on the structural steel per linear meter. Whereas in conventional heavy engineering factory buildings the load stress per linear meter varies between 200 and 300 kilograms, in the reactor assembly building the load level reached a maximum of 750 kilograms per linear meter.

HVAC Equipment

The engineering processes that take place in the main production areas of the reactor assembly building produce a considerable amount of heat and welding fumes, in addition to the fine metallic dust generated during the grinding of welds, and to some extent these processes also generate freely suspended CO, CO_2 and Ar. The point sources of these pollutants are not only very hard to identify, but the amount of pollutants generated is also highly variable depending on the workload of key operational areas.

Taking these facts into account, a decision was made to employ a system of combined plant-wide ventilation for both production bays of the reactor assembly building--the assembly bay and the hardening-room bay--i.e., a system based on the mechanical intake of filtered and, where necessary, preheated outdoor air.

The mechanical intake of filtered air is performed by a total of 25 HVAC machine rooms laid out in a uniform way and designed in accordance with the following parameters:

--volume of filtered air intake	100,000 m^3/h
--inlet pressure of fan	960 Pa
--fan electric motor power rating	55 kW
--heat flow for hot water heater	930 kW (928,000 kW/h)

The machine rooms designed to mechanically supply air to production bays No 1 and No 2 of the reactor assembly building are located on the upper floors of the south and north annexes. Similarly, the machine rooms designed to supply air to the assembly bay and the hardening-room bay are located on the upper floow of the east annex. As long as the outside temperature does not drop below 0°C the air-conditioning machinery will continue to draw in outside air only for ventilation. When outside temperatures drop below 0°C the machinery ventilates the building with a 50 percent mixture of recycled inside air. The ductwork piping equipped with anemostatic outlets manufactured by the STROJTEX plant at Dolni Bouzov runs along the south, north and east perimeter walls of the building.

The heated and polluted air is drawn out naturally through ventilation slots arranged in groups at several places both in all of the perimeter walls and also in the sidewalls of the rooftop illumination-ventilation hatches.

The assembly bay, which does not contain any major pollution sources, is not equipped with a rooftop skylight hatch. The hardening-room bay, where a considerable amount of surplus heat is generated, is equipped with an adjustable ventilation-illumination skylight with windscreens. All ventilation blades rotate around an upright central axis and are pneumatically remote-controlled from the factory floor.

From an efficiency standpoint the ventilation system also serves as a heat source, that is, it offsets a portion of the facility's heat-transfer loss. Since the width of the individual production bays is very large (30 and 36 meters), it is necessary to supply additional heat to work areas located furthest away from the ductwork piping of the mechanical air filtration system. To meet this need a total of nine BHB90 ventilation and heating units (manufactured by the Janka-ZRL plant at Prague-Radotin) were installed directly in the affected work areas of the reactor assembly building. These units heat adjacent areas by radiating warm air. They are equipped with filters and devices for preheating the circulated air with which they operate. They are designed in accordance with the following parameters:

--volume of circulated air	50,000 m^3/h
--inlet pressure of fan	520 Pa
--heater electric motor power rating	15 kW
--heat flow for hot water heater	465 kW (464,000 kW/h)

In order to facilitate the removal of pollutants from the factory building under adverse weather conditions, when the benefits of natural ventilation cannot be fully utilized, a total of 46 axial-flow APR 1000 fans (manufactured by ZVVZ [HVAC Engineering Equipment Plants], Milevsko national enterprise, Prachatice division), operated by separate controls, have been installed on the roof of the factory building. These fans were designed to incorporate reversible-action controls, so that, depending on the conditions of the moment, the air in the central section of the factory building can be evacuated or so that air from outside can be drawn in (of course without the benefits of filtration and preheating). The volume of air that can be expelled by each of the APR 1000 fans comes to 36,000 m^3/h.

Wherever necessary, the process work areas and equipment installations on the factory floor are equipped with vacuum and dust-removal machines which make it possible to eliminate or remove pollutants directly at their point of origin.

Most of the welder work stations will be provided with an additional supply of purified, deoiled and preheated air for the helmets of the welders (a special central assembly was designed for this purpose by the Skoda-Plzen sectoral enterprise).

Mechanical excess pressure ventilation will also be provided for all subsurface work areas in the reactor building itself and in the hardening room; the installation of this equipment will make it possible for workers to safely operate and maintain the relevant process equipment (the pressure testing pit, the hardening tank, shaft furnaces, undergound pump stations) even while they are in operation.

Electrical Engineering

In order to supply the electric power that was needed to run the plant structural design engineers had to make allowances for underground cable-run conduits with multiple branch circuits, and, in addition, they had to leave room in all surface and basement areas of the annex areas for distribution transformer stations and switchgear rooms.

installed power rating	42 MW
branch circuit power rating	18 MW
annual power usage	43,000 MW
installed power rating per cubic meter of factory floor space	1.7 kW

Compressed Air and Process Gases

The complexity of the production technologies used in this plant also means that heavy demands will be imposed on the piping used to distribute process gases. In addition to compressed standard and dried air, nitrous oxide, carbon dioxide, argon, oxygen and acetylene are also used. All process gases are fed into the reactor assembly building from the enterprise's central distribution piping system on a common pipework bridge together with the heating ductwork piping and the oil piping for the hardening-room bay (not including the piping that supplies carbon dioxide and argon). These gases are supplied from a separate source, i.e., an evaporation station in the reactor assembly building itself.

The compressed air is distributed under a pressure of 0.6 MPa and its rate of consumption under operational conditions amounts to approximately 12,000 m^3/h. Free air is used for engineering purposes and dried air is used for the pneumatic opening of window louvers in the perimeter walls and skylight hatches.

The rate of oxygen consumption under operational conditions amounts to approximately 260 m^3/h and the oxygen is distributed under a pressure of 1.5 MPa. The rate of installed acetylene consumption amounts to 50 m^3/h and the acetylene is distributed under a pressure of 0.07 MPa. In addition, an acetylene regulator station will be constructed for certain engineering processes that will operate under a pressure of 0.13 MPa.

The operational pressures for carbon dioxide and argon are 1.5 MPa and their rate of installed consumption amounts to approximately 30 m^3/h. Nitrous oxide is pressurized at 0.03 MPa and its rate of installed consumption comes to about 1,500 m^3/h.

All process piping systems are designed as all-purpose, closed-loop systems, and this was done both with a view to minimizing pressure losses and also with a view to the possible installation of additional branch lines in the event of future modifications of the production program.

The biggest problem associated with the design of these process piping systems consists in the making of decisions on the location of these systems in relation to other energy sources so as to insure compliance with all applicable rules and regulations.

Construction Contractor Requirements

The project's overall structural design (apart from the design of the structural steelwork) was also influenced by the demands levied on the general contractor in charge of construction work. Under the pressure of short project completion deadlines the general contractor tried to de-emphasize construction work per se in favor of the installation of more fully prefabricated components, while at the same time imposing vertical limits on "wet" processes.

The pressure of short construction deadlines and the shortage of skilled workers forced the contractor to make demands which resulted in the transformation of construction work into what amounted for the most part to installation work, work which was performed either directly by the contractor or by specialized subcontractor firms.

Listed below are some examples to illustrate how this process works:

--The underground cable-run conduits, for which it was originally proposed that prefabricated sections with solid branch lines should be used, were replaced by steel tubes made of corrugated sheet metal (Tubosider), the diameter of which equals that of the circumscribed circle of the original blueprint section.

--The office partition walls inside the individual fire protection zones were installed in one piece (using gypsum board) and papered.

--The ceilings of the annex areas are laid with concrete over corrugated, so-called basket sheet metal (part of the structural steel delivery contract).

--The roof also consists of basket sheetmetal (part of the structural steel delivery contract) covered with cellular concrete and roofing (supplied by the STAVOIZOLACE national enterprise).

--The wall covering material of installations inside the factory building is made of "Sidalvar," installed by the STAVOINDUSTRIA national enterprise of Bartislava.

--The walls of the annex areas are covered with "boleticky" [translation unknown] panels.

--The stairways in the annex areas are made of steel (part of the structural steel delivery contract).

--All doors into the factory building are non-standard and mechanically controlled (designed by KOVOPROJEKTA of Prague and delivered by Skoda-Plzen).

--The lining of excavated facilities with "Milan walls;" the walls were hoisted into place by Hydraulic Construction national enterprise.

The fulfillment of these requirements by the general engineer further made it possible to speed up the pace of construction work, even though the meeting of some of these requirements meant that, in contrast to standard procedures, capital outlays had to be increased. Even so the general contractor still had a lot of work to do not only in terms of the fulfillment of substantive tasks, but also in terms of its obligation to coordinate the activities of all subcontractors. And it nearly always happened and is still happening that subcontractors perform their assigned tasks concurrently.

Neither meticulous design planning nor the complex arrangements made for the actual construction of the reactor assembly building could not go very far toward meeting all of the requirements stipulated by current regulations governing capital construction projects. Consequently, official organs with jurisdiction over the project granted a whole host of exemptions and waivers so that the construction project could be brought to a successful conclusion. And it is indeed true that these actions were very helpful. The feasibility of the deadlines set for the completion of work on projects No 1 and No 2, whose capital costs amount respectively to Kcs 1,400,000,000 and Kcs 750,000,000 (see Table 2) and which must be completed within 60 months and ready for the phased startup of production operations, was and still is being determined by negotiations among the actual participants in the construction project. It was necessary to build up close-knit team which would be able, whenever critical work scheduling conflicts arose among the various contractors, to remain ever mindful of the ultimate objective and look for jointly agreed upon solutions to problems and not get bogged down in disputes. The dedicated and effective management of the construction work by the investor and by the management team in charge of on-site construction work and the assistance provided by on-site and higher-level party and trade union organs are deserving of the highest praise. The many joint socialist pledges which were made in connection with this construction project also played a critically important role.

The progress that has been made to date in fulfillment of the construction plan have laid a solid groundwork for the successful culmination of this project. The completion of this project will mark the fulfillment of one of the main prerequisites for the emergence of the CSSR as one of the world's leading producers of nuclear power plant equipment. The finished construction project itself could then serve as a pacesetting example not only of how to go about solving certain uniquely monumental problems, but also of how all participants in such projects should go about taking a constructive approach to the fulfillment of the tasks laid down by our country's capital construction policies.

Construction pit for the hardening-room of the reactor assembly building at Skoda-Plzen.

Southwest view of the reactor assembly building.

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200050034-7